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XXVIII.—*On a new Fossil Reptile supposed to be furnished with Feathers.* By A. Wagner*.

"A bird is known by its feathers," says the old proverb. The universal and exclusive applicability of this is recognized not only popularly, but also in zoology: an animal with feathers is a bird. This distinctive character, hitherto regarded as immoveably fixed, has all at once been brought in question by one of the most unexpected discoveries. The facts are as follows:—

In the course of the last summer I had the pleasure of receiving a visit from M. Witte of Hanover, who is well known to possess an excellent collection of fossils, and to be well acquainted with them; and on this occasion he informed me that he had seen, in the possession of M. Häberlein, of Pappenheim, a slab from the lithographic stone of Solenhofen, upon which there was a skeleton with such a combination of characters that nothing more surprising and odd could be imagined. This specimen, indeed, wanted the skull and the two hands, but in other respects the most important parts of the skeleton were well preserved. The most remarkable thing about it was that a well-marked coat of feathers was present both on the anterior limbs and on the tail. These feathers agreed in their configuration so exactly with those of true birds, that their interpretation as such could hardly be doubted. The discovery of feathers in the lithographic slate was of itself something unprecedented, but the mode of their union with the skeleton bordered on the incredible. Thus the tail-feathers were attached to a tail possessing not the least resemblance to that of a bird, but presenting a deceptive similarity to that of a *Rhamphorhynchus*. And the attachment of the wings was still more astonishing; for these, on both the anterior limbs, formed a fan radiating from the extremity of the fore-arm.

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* Translated by W. S. Dallas, F.L.S., from the 'Sitzungsberichte der Münchner Akad. der Wiss.' 1861, p. 146.

"Obstupui, steteruntque comæ!" The statements made to me by my friend were so unexpected and so much at variance with previous views, that at first I did not know what to think of them. Whether I regarded this mongrel creature as a bird with the tail of a reptile, or as a reptile with bird's feathers, was no matter; the one was as incomprehensible to me as the other. Nevertheless this singular information came to me from a man whose judgment I could not but respect as that of one well acquainted with the subject. Nothing, therefore, remained for me but to suspend my judgment for the present, and leave it to time to furnish further elucidations of this matter. A long absence, however, prevented my further investigating the affair.

The first contribution towards the completion of my knowledge of this extraordinary animal was furnished by H. von Meyer, in the lately published fifth part of the new 'Jahrbuch für Mineralogie,' &c. (1861, p. 561), where he reports as follows:—"A fossil from the lithographic slate of the quarries of Solenhofen has been sent to me, showing, with great distinctness, a feather which cannot be distinguished from those of birds. In the organization of the Pterodactyles, which is now so accurately known, there is nothing from which we might infer that those animals were clothed with feathers; this, therefore, would be the earliest trace of a bird belonging to pre-tertiary time. The feather, which is of a blackish appearance, is about 60 mill. in length; and the vane, which gaped somewhat here and there, almost uniformly 11 mill. in breadth. The fibres on one side of the shaft are only about half as long as those on the other. The quill, which was pretty strong, is also indicated. The vane terminates in a somewhat obtuse angle. The feather will represent either a wing- or tail-quill."

We have thus, from one of the best of our palæontologists, a full confirmation of the correctness of the interpretation given to these parts by M. O. J. Witte; for that this isolated feather belongs to the same type with that seen by the latter is open to no doubt in my eyes, even from the statement of their derivation and the first discovery of such structures in lithographic slate, and it will receive further confirmation immediately, inasmuch as I have obtained from one of my friends, who is perfectly acquainted with his subject and was aware of the statements of the two palæontologists above mentioned, a report upon the same slab which M. O. J. Witte had the opportunity of seeing. Although he had not time to undertake a minute comparative examination of the slab, he was still able at least to acquire an accurate notion of its principal parts. His report runs as follows:—

"Skull, neck, and both hands wanting. Of the vertebral column, the greater part of the vertebræ of the trunk and the whole of those of the tail are completely preserved. The former are of moderate length, and uncovered; the tail, which measures upwards of 6 inches, consists of about twenty vertebræ of an elongate narrow form, the dimensions of which slowly but constantly diminish, so that the last of them is the smallest. Of the anterior limbs, the humerus and fore-arm are present on both sides; they are strong bones, pretty nearly of equal length, and the fore-arm consists of radius and ulna. At the anterior extremity of each fore-arm there is a broad, short bone, but this is injured.

"Of the pelvis only the right half is preserved; it is but small, and is comparable not with the pelvis of a bird, but rather with that of a Pterodactyle. On the left side, the whole hinder extremity is preserved; on the right, only the thigh and shank. The former is a powerful and not very long bone; the latter is somewhat longer and thinner, and is simple; at least, a separation into tibia and fibula is not perceptible. The tarsus consists only of a single powerful bone, which is shorter than the shank-bone with which it is in contact; its lower extremity is considerably widened, and bears three articular processes, to which the three toes are attached. The latter are of moderate length, and armed with strong hooked claws.

"Feathers occur both on the anterior limbs and on the tail; they have, however, left only their impressions, but these show sharply defined outlines, and upon a passing glance they present a deceptive resemblance to birds' feathers. From the above-mentioned short broad bone, which lies close to the extremity of each fore-arm, there issues a radiate fan of feathers, by which therefore, as a structure of this kind radiates from each fore-arm, two feather-wings are produced, having their external outline curved like a bow. The individual feathers are characterized by their fine shafts, on each side of which the delicate striation of the vanes is seen. The largest of these feathers considerably exceed in size that described by Von Meyer.

"Similar feathers are attached to the tail, but with this distinction, that they do not attain the length of the wing-feathers, and, which is of more importance, they do not radiate like the latter from a central point, but spring from both sides of the tail throughout its whole length, and start from it at a small angle. The tail-feathers form a group of an elongated leaf-like or oval shape, of which the narrow end issues from the beginning of the tail, whilst the posterior end is broadly rounded, and extends considerably beyond the last caudal vertebra."

So far this summary report, which thus fully confirms the statements of M. Witte, but at the same time furnishes further important data for the interpretation of this extremely enigmatical fossil, which I shall now attempt. The business now is to ascertain whether this animal, which exhibits at the same time characters belonging to birds and reptiles, is to be referred to the class of birds or that of reptiles. Let us first consider those characters which connect it with birds, and then those which unite it with reptiles.

The most striking resemblance to a bird consists in the clothing of the anterior limbs and the tail with feathers. Feather-formation is only known in birds. Another characteristic similarity to birds is shown by the tarsus, which forms a single bone, but has at its lower extremity three processes for the articulation of the three toes. This structure occurs in all birds, but has not yet been observed in any reptile.

The characters which do not agree with the type of birds are the following:—A divergence of this kind is shown, in the first place, even by the feathers themselves as regards their mode of attachment. . The wing-quills of birds are inserted along the whole outside of the hand and fore-arm; in the fossil now under consideration, which unfortunately wants the hand, the fore-arm shows no feathers; and, moreover, the whole wing is attached only to a small bone lying close to the fore-arm, and therefore probably belonging to the wrist, from which it radiates like a fan. Equally strange is the mode of attachment of the feathers on the tail, from which they issue on both sides throughout its whole length uniformly amongst themselves, whilst the rectrices on the short tail of birds are only attached to the last vertebra. As such a mode of attachment of the feathers of the wing and tail is quite foreign to birds, the question finally arises whether these fossil feathers are actually identical structures with true birds' feathers, or only present the external appearance of these. The microscopic examination of their structure and the chemical investigation of their substance might furnish the most certain solution of this doubt.

The structure of the vertebral column is totally different from the type of birds, but, on the other hand, it agrees most closely with that of the long-tailed Pterodactyles (*Rhamphorhynchus*). In birds, the sacral and lumbar vertebræ, and the nearest of the dorsal vertebræ, are not only firmly anchylosed together, but also, on the outside, covered by the long lumbar sacrum in the manner of a roof. In the fossil, on the contrary, the sacral and lumbar vertebræ are free and uncovered, and the lateral bones of the pelvis are but slightly developed. The difference in the structure of the tail is equally striking. All birds, without exception, have a very short and powerful tail, composed of from five to eight, and only in a few cases of nine or ten vertebræ, which bear strong processes, and of which the last is always peculiarly formed, and also, with but few exceptions, the largest. The opposite of all this is exhibited by the tail of the fossil. In this the tail is extraordinarily long, and consists of about twenty vertebræ, which are all elongated, slender, and without processes, and the last of them is the smallest. Such a condition of things is completely in contradiction to the bird-type, but, on the other hand, agrees very closely with that of *Rhamphorhynchus,* in which, moreover, radiating processes issue from the caudal vertebræ, although these are not feather-like, but appear to be simple cartilaginous fibres.

I have thus detailed those data which have become accessible to me, in order to endeavour to answer the question whether this fossil is to be referred to the class of birds or to that of reptiles. The difficulty of doing this with certainty is indeed greatly increased by the circumstance that the skeleton is entirely destitute of certain extremely important parts, of which the skull and the hand may be particularly adduced; nevertheless an attempt at some interpretation must be ventured upon. In the first place, I consider the great uniformity, especially in the structure of the skeleton, presented by the type of birds, which, in comparison with that of the other classes of Vertebrata, only admits of inconsiderable variations; whilst amongst the reptiles—and as in the present case we have to do only with the Saurian order, in these, the most remarkable differences occur within the boundaries of the order, as may be seen from living and still more from extinct species of Sauria. For this reason, therefore, a reptile with the simple tarsal bone of a bird, and with epidermic structures presenting a deceptive resemblance to birds' feathers, is far more comprehensible to me than a bird with the pelvis and vertebral column (especially the long slender series of caudal vertebræ) of a long-tailed Pterodactyle, and with a perfectly different mode of attachment of the feathers. To this we may add that the identity of these epidermic structures with true birds' feathers is by no means proved; they might still only be peculiar adornments. Even amongst insects we find peculiar structures, to a certain extent reminding us of feathers; why, therefore, not also, and in a higher stage of development, among reptiles? If nothing of the kind has yet been found in the latter class, we have already been accustomed in palæontology to meet, in recent discoveries, with previously unknown peculiarities in the structure of different organs. Consequently, until I shall be convinced by the discovery, in another specimen, of the parts wanting in the one now under consideration, I do not hesitate to regard this as a reptile of the order Sauria; and I give it the name of *Griphosaurus*, derived from γρῖφος, an enigma.

This singularly constructed Saurian might also assist us in the solution of another mystery which has not yet been unveiled. It is well known that in certain strata of the Trias we meet with impressions which have been regarded as the *footprints of birds*, although no bones of birds have yet been discovered in any of the Secondary rocks older than the Chalk. As far as these impressions (the signification of which has hitherto always appeared to me very doubtful*) may be actual footprints of animals, we should at least become acquainted in the *Griphosaurus* with a reptile with birds' feet, or, more properly, a reptile with the tarsus of a bird, the footprints of which must therefore have been like those of a bird. By this I do not mean to say that these supposed footprints of birds are due to our new genus, but I only wish to furnish an effective support for the supposition that these footprints are produced not by birds, but by reptiles of an extinct type. In this way also the sequence in the appearance of the Vertebrata, as ascertained from the remains of their skeletons discovered in the rock-beds, would be brought into accordance with the observations of the footprints, in so far as these are truly what they are said to be. The supposed birds' footprints of the Trias would thus by no means be produced by birds, but by reptiles; they would be reptile-tracks.

In conclusion, I must add a few words to ward off Darwinian misinterpretations of our new Saurian. At the first glance of the *Griphosaurus* we might certainly form a notion that we had before us an intermediate creature, engaged in the transition from the Saurian to the bird. Darwin and his adherents will probably employ the new discovery as an exceedingly welcome occurrence for the justification of their strange views upon the transformations of animals. But in this they will be wrong. If I say of the Frog that it was originally a fish, I can at least justify such an assertion; because I can positively show by specimens the transition of the fish into an Amphibian, from the first states of a fish-like tadpole through a whole series of intermediate steps. I cannot indeed require that, in regard to *Griphosaurus*, Darwin should show me such intermediate steps, for of this genus we only know a single and imperfect specimen; but I am entitled to ask of the Darwinians, if they should desire to cite the *Griphosaurus* as an intermediate creature undergoing a transformation from a reptile into a bird, to show me, first of all, the intermediate steps by which the transition of some one living or extinct animal from one class into another was effected. If they cannot do this (as they certainly cannot), their views must be at once rejected as fantastic dreams, with which the exact investigation of nature has nothing to do.

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* See my 'Geschichte der Urwelt,' ii. p. 423.

XXIX.—*On the Remains of Fish and Plants from the Upper Limestone of the Permian Series of Durham.* By JAMES W. KIRKBY.

THE fossils provisionally noticed in this communication have been found in the Upper Limestone of the Permian series of Durham. The most important of them are the remains of Fish, most of which appear to be undescribed. The others, which are the least numerous, belong to vegetables.

Previous to the discovery of these fossils the remains of fishes were not positively known to occur so high in the Permian series of the district named, the Marl-slate being the chief and almost only subdivision in which they had been found. The Marl-slate is nearly at the bottom of the series; the Upper Limestone is almost at the top, it being the uppermost member, with the exception of the Bunter Schiefer, which is unrepresented in the immediate region where these fossils occur. Hence they are amongst the latest—if not themselves the latest—traces that we possess of palæozoic Vertebrata.

The locality where the fossils are found is in a quarry belonging to Sir Hedworth Williamson, Bart., at Fulwell Hill, near Sunderland. The bed in which most of them occur is not more than 2 feet thick. It is mostly laminated and very fissile, and it varies from a soft, earthy, yellow limestone to one that is hard, crystalline, and grey.

Nearly all the fish are small *Palæonisci*, the largest of which is only 4 inches in length, most of them being less. Fragments of a larger fish, apparently belonging to the genus *Acrolepis*, have also occurred, as well as impressions of others, intermediate in size, which are so obscurely preserved as to prevent any decision as to their affinities.

1. *Palæoniscus varians*, n. sp.

Maximum length 4 inches; greatest depth 1 inch or a little more. Head somewhat less than one-fourth of the entire length, and a little longer than wide; orbit large, and placed well forward; mouth of medium size; operculum large, and covered with delicate rugose ornamentation. Pectoral fins small; ven-